ing its presence than has heretofore been employed becoming obvious when, as shown by me in the case of *Gromia* (and as I believe will be found to be the case in every one of the naked Rhizopods which have hitherto been relegated to the lowest order of that group of organisms chiefly on account of being supposed to be deficient in this organ), it is almost certain that the error has arisen from the extreme difficulty, often encountered, of rendering the nucleus visible. The superiority of the method I am about to describe consists in its being simple, easy of application, and sure.

During some experimental trials I was making on the effect of a galvanic current passed through the water on slides containing living *Amœbæ* and other organisms, which generally resulted in their being instantaneously killed without rendering their internal organization more distinct than it was before, it occurred to one of my sons to try the effect of ordinary frictional electricity. The result proved most gratifying; for although, as in previous cases, the *Amœbæ* were instantly killed, their entire bodies were at the same time burst up, so to speak, into a homogeneous-looking mass of granular particles, the nucleus, however, in every instance forming a conspicuous object in the midst of these. So marked was this result that in some perfectly clean gatherings of *Raphidiophrys elegans*, so numerous that each field of the microscope was simply crowded with them, but in none of which a nucleus could be previously discerned, the instant the discharging knobs communicating with a single small Leyden jar were applied on opposite sides of the glass cover, and of course in contact with the water between the cover and slide, the effect I have described was produced in every one of them. The only precaution that has to be attended to is not to employ too powerful a discharge.

VI.—*Descriptions of Sponges from the Neighbourhood of Port Phillip Heads, South Australia, continued.* By H. J. Carter, F.R.S. &c.

[Continued from vol. xvii. p. 516.]

Order VIII. CALCAREA (*continued*).

Observation.

Following Polèjaeff's arrangement the Sycones will be inserted here, that is before the Leucones, as the radial chambers in the simplest and most typical forms, ex. gr. *Grantia ciliata*, Bk. (*Sycandra ciliata*, H.), appear to be closely allied

in structure to the tubulation of the Ascones, where the latter begin to present "parenchyma," inasmuch as the radial tube of *Grantia* is solely composed of a spicular skeleton consisting of a single layer of small radiates, whose interstices are tympanized by sarcode plentifully traversed by pores, and whose intervals are filled with parenchyma supporting the young ova &c., with Häckel's "intercanal system." Indeed the amount of parenchyma in *Clathrina ventricosa* far exceeds that to be found in any of the Sycones, as will be seen hereafter, and thus, as before stated, in this respect it more nearly approaches Häckel's Leucones (ex. gr. *Leucaltis floridana*) than any of the Sycones.

9. *Sycandra Ramsayi*, von Lendenfeld.

Sycandra Ramsayi, von Lendenfeld, Proc. Linn. Soc. New South Wales, vol. ix. pt. 4, p. 1097.

This sponge, which has been well described and illustrated by Dr. R. von Lendenfeld (*op. et loc. cit.*), is easily recognized by its comparatively large size and the closeness of the hairy surface, which has been so much worn away in my specimens that it now looks like a "shoe-brush" or the coat of a "clipt" horse. The tufts of spicules with which it is covered are so close together that the surface instead of being granulated by them, as in *Grantia ciliata*, is continuously uniform, so that the whole, including the long stout peristome, has when dry a glistening silky appearance; still, by pushing aside the tufts, the usual pore-areas may be seen between them which also respectively cover their radial chambers on the outside; but this is not shown in Dr. Lendenfeld's illustration (*op. cit.* pl. lxvi. fig. 37). Internally the holes of the cloaca, although honeycomb-like in appearance, are almost circular, and so generally in apposition that it is only here and there that any "intercanal" space for the parenchyma can be seen between them; their margins are sparsely echinated with the fourth ray of the quadriradiate, which is comparatively short, and the radial chambers extending outwards from them are long and skeletally "articulated" with characteristically small, thin, triradiate spicules of much the same size, but for the most part sagittal in form. The minute acerate spicules from the base of the tufts represented by Dr. Lendenfeld form part of the medium of attachment between the tufts and the elongated shafts of the triradiates at the outer end of the radial tube; these are sinuous and larger

at one end than the other, which is lance-pointed *, altogether about 13 by $\frac{2}{3}$-6000th in. in their greatest dimensions—in short they form Häckel's "Stäbchenmortel," and are what I have proposed to call "mortar-spicules." Of the terminations of the long acerates of the tufts I know nothing, as they are all broken off except a few of the shorter ones, which are *simply* pointed. The most complete specimen of this species in Mr. Wilson's collection is much compressed, about 1 in. long and $\frac{3}{4}$ in. broad; with a large peristome of glistening, silky, fine acerates now arranged conically, altogether about 3-24ths in. in diameter at the base and 5-24ths in. long, which, of course, is the diameter of the mouth.

10. *Grantia subhispida.*

Individualized. Sacciform, elongate, somewhat pyriform, diminishing in size abruptly towards the free and gradually towards the fixed end. Surface presenting a checkered appearance owing to the presence of lines crossing each other spirally and obliquely upwards, at the intersections of which a tuft of long projecting spicules is situated, and in the intervals a cribrate, stelliform area, arched outwards. Pores in the dermal sarcode stretched over these cribriform areas, in short the holes of the cribriform structure itself. Vent large, single, terminal, subcircular or twisted, like a slit nostril; surrounded by a palisading of long linear spicules, leading into a cloaca which corresponds in shape to that of the specimen, and whose surface is scattered over with holes separated by a thick spicular framework; holes not superficially sphinctered, but presenting two or more sphinctered openings *within* the margin belonging to the internal structure. Wall composed of radiating cylindrical chambers in juxtaposition, whose skeletal structure is "articulate," tympanized with sarcode, pierced by the usual pores of intercommunication, and more or less accompanied by parenchymatous or intercameral intervals; outer ends of the chambers respectively covered by the spicular tufts and cribriform areas, and their inner ends opening in pairs, within the holes of the cloaca respectively, as before stated. Spicules of three kinds, viz. acerate, triradiate, and quadriradiate:—1, acerates, of two forms, viz. one long, fine, linear, straight and simple, pointed at each end, arranged parallelly to each other around the mouth; the other much stouter, curved, simple or lanceolate at one end, chiefly

* When the word "lance" is used with reference to the form of the end of a spicule, it must be understood to mean lozenge-shaped or conical as the case may be.

arranged around the external ends of the radial chambers to which they belong. 2, triradiates, varying in size and shape according to their position, that is from an equiangled to a sagittal form in which the arms are much expanded. 3, quadriradiates, whose fourth arm is short, curved towards the mouth, and projects into the cavity of the cloaca. No. 1 in its thin form is confined to the peristome, and in its stouter one to the tufts on the surface of the body, mingling also with the proximal ends of the peristome-spicules; no. 2 chiefly to the spicular skeleton of the radial chambers, which is thus "articulate;" and no. 3 chiefly to the cloaca, where its fourth arm thickly echinates the surface and circular holes of this cavity. Size of largest specimen, of which there are two, $1\frac{1}{4}$ in. long by 4-12ths in. in greatest diameter, which, the specimen being pyriform, is towards the free end; vent or mouth about $\frac{1}{6}$ in. in its greatest diameter.

Obs. This species, although closely allied to *Grantia ciliata*, differs from it in several particulars, viz. first in the pore-areas being much more circularly defined, arched outwards, and presenting a stelliform appearance; secondly, in the radial chambers being of the same size throughout, while in *Grantia ciliata* they widen outwards; and thirdly, in two or more openings of these chambers opening *inside* the holes of the cloaca respectively, while in *Grantia ciliata* each chamber has its appropriated opening in the cloaca, and each is sphincter-ed by a sarcodic diaphragm. The smaller specimen is charged with ova about 1-400th in. in diameter when dry, which possess the germinal vesicle and *now* are evidently *on the surface* of the radial chambers as much as in the parenchyma, where they are also present.

With reference to the position of the ova, they *must* be developed *ab initio* from the surface of the chamber or tube in *some* instances, as in the *Clathrinæ*, ex. gr. *C. osculum* &c., where the internal surface of the tubular thread of which it is composed is plentifully charged with them; since here there *can* be no "parenchyma," for there is no place for it.

11. *Grantia compressa*, auct.

The specimens of this species have grown on a small feathery *Fucus* in much the same condition as they grow here (Budleigh-Salterton, S. Devon).

12. *Grantia compressa*, var. *fistulata*.

The only difference between this and the usual compressed form of *G. compressa* is that it is tubular; it grows in a bunch contracted to the point of attachment, in which the individuals

are about 1 in. long by 1-16th in. in diameter, singly or bifurcated.

13. *Sycothamnus alcyoncellum*, H.

Sycothamnus alcyoncellum, H., Kalkschwämme, Atlas, Taf. lviii. fig. 5.

Easily recognized by its hollow, cylindrically-branched, coral-like form, checkered on the surface by spirally-intercrossing lines extending round the cylinder, with holes at the points of intersection. There is nearly as much as would fill a half-pint cup of this, all of which is in a fragmentary condition, wherein the naked and peristomed varieties (*S. arboreum*, H., fig. 7) appear to be mixed. In some of the "mortar-spicules" which Häckel describes in his text-book but does not represent in the 'Atlas,' the lanciform ends are serrated, like those of his *Leucandra saccharata* (Taf. xxxviii. fig. 13).

14. *Teichonella labyrinthica*, Carter.

Teichonella labyrinthica, Carter, 'Annals,' 1878, vol. ii., p. 37, pl. ii. figs. 6–10.

There are several specimens of this species, respectively complete and fragmentary, which enable me to modify to a certain extent what I stated formerly respecting it, inasmuch as the less involuted specimens show that it is goblet-shaped in general form and *not* simply "vallate," like *T. prolifera* (*op. et loc. cit.*); also that a *quadri*radiate forms part of its spiculation; hence these additional facts render it necessary that it should be relegated to the vicinity of *Grantia compressa*, where its generic name might be changed from "*Teichonella*" to "*Grantia*." It was the absence of the lower part and the imperfect state of the specimen generally that led me in the first instance to call it "vallate." As the structure of the stem has not already been noticed, it may be here stated that it consists of a solid, cylindrical, somewhat compressed mass of spicules, chiefly fine triradiates with very long shafts, and echinated with large, long, curved, fusiform acerates on the surface, which are partly free and partly imbedded in the general fabric. The largest specimen is $2\frac{1}{4}$ in. high, not including the stem, and 3 in. across the brim of the head when involuted; while the maximum thickness of the wall, which is towards the base, is 3-24ths in., diminishing gradually towards the border. The stem, which is somewhat contracted near the middle, is an inch long and about $\frac{3}{8}$ in. thick, expanding upwards into the wall of the head and downwards upon the object on which it has grown. One cannot help seeing in the compressed form of the involuted folds of the

head, which altogether is only $1\frac{1}{2}$ inch in its shortest diameter, while its longest, as above stated, is 3 inches, another character of *Grantia compressa* and its varieties.

The crater- or basin-like form, together with the arrangement of the excretory canal-system, causes this sponge to be very analogous in these respects to *Carteriospongia*, Hyatt, among the Keratosa, wherein the openings of the latter on each side of the wall being opposite each other, causes the specimen to present a cribriform appearance when placed between the observer and the light.

Observation.

We have now to leave that portion of Mr. Wilson's collection in which the typical form of the "radial chamber," viz. that in *Grantia ciliata*, which consists of an unbroken cylinder extending directly across the wall from the cortex to the cloaca, is replaced by a *sub*radial structure, in which the typical radial parallelism is more or less lost by the addition of large holes of intercommunication, more or less equal in diameter to the chambers themselves, which thus introduces a branching structure that is better seen in the vertical or horizontal section of the specimen than in the tangential one of the wall, in which the ends of the chambers appear to be almost as regular and as much in juxtaposition as they would be in *Grantia ciliata*. Hence the calcareous sponges presenting this "subradial" structure will be generically termed "*Hypograntia*" under the following diagnosis:—

Hypograntia.

Calcareous sponges in which the typical or radial structure of *Grantia ciliata* is more or less diverted from its parallelism by the addition of large holes of intercommunication between the chambers.

15. *Hypograntia infrequens* (incertæ sedis).

Individualized. Pyriform, sac-shaped, bent upon itself, peristomed. Colour whitish yellow outside, ferruginous within. Surface even, uniformly composed of large triradiates, fixed in their position by sarcode charged with minute mortar-spicules. Pores in the structure last mentioned. Vent single, terminal, circular, surrounded by the peristome, leading into a narrow cylindrical cloaca, corresponding in shape with that of the specimen; holes in the cloaca small, tolerably regular both in size and approximation, each provided with a sarcodic sphincter, like those of *Grantia ciliata*;

surface and holes of the cloaca thickly echinated with the fourth arm of quadriradiates curved towards the mouth. Structure of the wall consisting of radial chambers, most evident on the cloacal side, where they are defined by the long shafts of triradiates, whose heads are against the cloaca and whose shafts, directed perpendicularly outwards, abut upon the cortex, which consists of several layers of tolerably large triradiates, and is thus very thick; chambers uniformly pierced by pores alone until arriving at the cortex, where their continuity is broken up by the presence of large holes of intercommunication, which are continued to the pore-areas of the surface through a similar structure in the midst of the cortex. Spicules of three kinds, viz. acerate, triradiate, and quadriradiate:—1, acerates, of two forms, viz. that common to the peristome in general and that of the surface, the latter minute and sinuous, with one end enlarged and lanceolate, in short the "mortar-spicule," about 28 by 1-6000th in.; 2, triradiates, also of two forms, both large, viz. those which compose the cortex, which are more or less regular, and those whose long shafts define the radial portion of the chambers, where they average 115 by 12-6000ths; 3, quadriradiates, with large, ensiform, curved fourth arms. No. 1 is confined to the peristome and surface; no. 2 to the cortex and interior of the wall, where the heads of the "long shafts" rest against the cloaca; no. 3 to the surface of the cloaca, where the fourth arm, which is stout, ensiform, and curved towards the mouth, *profusely* echinates the whole surface. Size of specimen about 6-12ths in. long by 2-12ths in. in its greatest transverse diameter.

Obs. The structure of this specimen so gave way that it became crushed under the knife while making the section; thus the wall and cloaca together became separated from the cortex. This in part might have been occasioned by decomposition, as indicated by the ferruginous colour of the inner portion; but it may be here stated that it is very likely to occur where the spicules are large and thick, on account of the little resistance then afforded by the sarcode; hence the advantage to be gained by imbedding the portion in paraffine, when the spicules are so firmly kept in their natural position that during the section they cannot swerve from it. There is enough present, however, in my section to show that there is still a portion of the typical radial chamber left in this species, and that it is "inarticulate;" while the thickness of the cortex, exceeding that of any other specimen in the collection, is very remarkable.

16. *Hypograntia hirsuta.*

Individualized; solitary or social. Sacciform, cylindrical, elongate, diminishing towards the free end, which is provided with a long peristome, also towards the fixed one, which is contracted to the point of attachment; covered with a hairy coat of long spicules, which together with the peristome when dry gives the whole a glistening silky appearance. Colour light grey. Surface overspread with tufts of acerate spicules in the midst of circular cribriform areas, which are more or less arched outwardly. Pores identical with the holes of the cribriform structure, which are comparatively large. Vent single, terminal, leading to a cloacal cavity corresponding in shape with the specimen, a little wider in the centre than the wall, which is comparatively thick; abundantly echinated with the fourth arm of the quadriradiate; holes of the cloaca large, irregular in size and distance apart, being more or less separated by the interspaces which the varying breadth of the superficies of the cavity presents; showing within the margin, which is profusely echinated, segments of one or more circular sphincter-ed openings which belong to the structure of the wall. Structure of the wall consisting of subradial chambers, *i. e.* only partly radial, arising from the radial form being more or less diverted from parallelism by large holes of intercommunication, besides the usual pores, especially in the outer and inner sides of the wall, where, in the former, they simulate the "subdermal cavities," and in the latter "subcloacal" ones also; opening in more or less plurality just inside the holes of the cloaca, as above stated; skeletally composed of small radiates, *i. e.* "articulated." Spicules of three kinds, viz. acerate, triradiate, and quadriradiate:—1, acerates of two forms, viz. one thin, smooth, straight, long, silky about the mouth, and the other thicker, curved, and disposed in tufts about the body; 2, triradiates varying from regular to irregular or sagittal; 3, quadriradiates, the same, of which the fourth arm may average 20 by 2-6000ths. No. 1 confined to the peristome and tufts of the surface respectively, where the latter in combination forms a cone over the outer part of its chamber; no. 2, chiefly confined to the wall-structure and the surface respectively, where, in the latter, their rays support the cribriform sarcode, arching over the ends of the chambers which are not occupied by the "tufts;" and no. 3 to the cloaca, where the fourth arm thickly echinates the surface and margins of the holes of this cavity, as before noticed. Size of largest specimen (for there are several) about 9-12ths in. long, exclusive of the peristome, and 5-12ths

in. in greatest diameter, that is in the middle; cloacal cavity 3-24ths in. in diameter in the middle.

Obs. At first sight this looks very much like *Sycandra Ramsayi* from its hairiness; but when examined minutely it is found to present the structure above stated, which allies it almost as much to the Leucones as to the Sycones, hence the wall-structure is a mixture of both. The sarcode of the chambers is plentifully beset with ova, which appear to be in the last stage of segmentation.

17. *Hypograntia sacca*, von Lendenfeld, sp.

Grantessa sacca, v. Lend. *op. et loc. cit.* p. 1098, pl. lx. fig. 41, and pl. lxiii. fig. 42.

Individualized. Specimen large, pyriform, compressed to flatness, sacciform, somewhat bent upon itself, free and open at the small end, which is truncate and bears the remains of a peristome that has been broken off, so that, at first sight, it appears to be naked or without one; convex at the large end, where the point of attachment was by the most prominent part. Colour sponge-brown. Surface consisting of cribriform sarcode densely charged with small radiates, through which project a number of glistening cones consisting of long acerates; pores of the cribriform structure large, averaging about 1-207th in. in diameter, or just half the size of the holes in the cloaca; cones irregular in form, of different sizes, and at various distances apart, averaging about 1-415th in. in diameter at the base, and 1-207th in. from each other; but all broken off in the specimen, so that their length cannot be ascertained. Pores in the cribriform structure as just stated. Vent single, terminal, amounting in the compressed state of the specimen to a mere slit about 5-12ths in. long; furnished with a peristome, which has been broken off close to the lip; leading into a large cloacal cavity, which, on account of its compressed form, measures $1\frac{1}{2}$ in. in its greatest diameter; thickly scattered over with subcircular holes averaging 1-60th in. in diameter, or twice that of the "pores," as before stated, arranged for the most part in groups of three and four together, at variable distances apart, depending on the breadth of the intervening skeletal structure of the cavity; presenting *within* their borders one or more openings of the wall-structure; scantily echinated with short spines, that is the fourth arm of quadriradiates. Structure of the wall, which when compared with the diameter of the cloaca is very thin, not being more than 1-16th in., much the same as in *Grantia hirsuta*. Ends of the chambers of the wall-structure externally covered by the cribriform sarcode and the cones respectively. Spicules of three kinds, viz. acerate, triradiate,

and quadriradiate :—1, accrates, long, thin, cylindrical, glistening, silky in both peristome and cones, but, owing to the friction to which the specimen has been exposed, all, as before stated, broken off so short that their dimensions in length cannot be given, although, as usual, the length may be assumed to have been considerable. Dr. v. Lendenfeld estimates it (*l. c.*) at "2–3 millim.," say about 5-48ths in. long. 2, triradiates, comparatively small, regular, and irregular or sagittal, and of variable size. 3, quadriradiates, which are very scanty. No. 1 confined to the peristome and cones, those of the latter spreading out tent-like over the outer ends of their chambers, and sinking deeply into the parenchyma; no. 2 to the wall and its limiting layers, viz. that of the surface and that of the cloaca, uniformly and comparatively small throughout; and no. 3 to the surface of the cloaca and margins of the pores on the surface where the scanty presence of the curved fourth arm indicates that of the quadriradiate itself. Size of specimen, whose sides are closely approximated, 2 in. long, by $1\frac{1}{2}$ in. in its widest diameter.

Obs. Although this species, in its dead state, is so much compressed, it is doubtful how far this would be the case when living undisturbed in its habitat. As it appears to be the same species as that described by Dr. R. v. Lendenfeld (*l. c.*), I have adopted his specific name for it. The surface in a dried specimen affords a beautiful object for the microscope, and altogether is so strikingly characterized that it only needs to be studied once to be unmistakably recognized thereafter.

The smaller specimen of this species, for there are two, appears to be in a better condition than the large one, inasmuch as it is stouter, though still somewhat compressed, and plentifully charged with ova, in apparently the "planogastrula" stage, situated chiefly on the *surface* of the chambers; but without any traces whatever of the small granuliferous spermatic-like cells seen where the ova are *not* in such an advanced stage of development. It is about an inch long and half an inch its longest diameter, containing a large crustacean in the cloaca quite ready, when living, to devour the embryos as they were discharged from the parent.

18. *Hypograntia extusarticulata.*

Agglomerated. Specimen consisting of a large bunch of long and short, more or less inflated, cylindrical sacs, with conotruncated ends; growing irregularly out of each other towards the base, all scantily peristomed. Colour whitish yellow on the surface, sponge-brown within. Surface even,

composed of uniformly cribrated sarcode densely charged with "mortar-spicules" and small triradiates, giving it a rough compact aspect. Pores, the holes of the cribriform structure, all tolerably uniform in size. Vents single, terminal, circular, at the end of each of the individuals; each provided with a short peristome, and each leading into its own cloaca, which corresponds in shape to the form of the individual, but is so much broader than the wall that the latter looks like a mere shell; holes numerous, small and great, but still tolerably uniform, permitting more or less of the openings of the wall-structure to be seen within them, according to their size; separated by the skeletal structure of the cloaca, which consists, like the surface of the body, of small triradiates, but with *no* "mortar-spicules." Wall thin, about 1-30th in. in diameter, consisting of subradial chambers like those of *Grantia hirsuta*, but more broken up in their parallelism by the large holes of intercommunication; covered by the pores of the surface externally, and opening, as before stated, into the holes of the cloaca internally; mixed in their skeletal structure, which consists of the "articulated" form *externally*, and the "inarticulated" one *internally*, but all comparatively small; thus the inner radiates of the "inarticulated" portion, which are the largest, have their sagittal heads fixed in the cloaca, while their shafts extend outwards horizontally to about the middle of the wall. Spicules of three kinds, viz. acerate, triradiate, and quadriradiate:—1, acerates, long and short, the former fine, cylindrical, straight, and similarly pointed at each end, and the latter short, minute, more or less sinuous, fusiform, and lance-pointed at one end, about 15 by $\frac{3}{3}$-6000th in.; 2, triradiates, regular and irregular, comparatively small throughout, the larger, as before stated, on the inner side of the wall, where their shafts average 60-6000ths in. long; 3, quadriradiates, also regular and irregular in their triradiate portion, provided with a thick, curved, fourth arm. No. 1, in its two forms, is confined to the peristome and cribrate sarcode respectively, where the latter, which are the "mortar-spicules," mingle (as is the wont of the dermal acerate when present) in a larger form with the proximal ends of the peristomes; no. 2 is common to the wall and its limiting layers on each side, viz. the cloaca and the cortical layer on the surface of the body; no. 3 is chiefly confined to the surface of the cloaca, where its fourth arm, which projects into the interior of this cavity, is thick and curved, but not plentiful. Size of specimen, which, being an agglomeration, is of course very irregular, about 2 in. long by 1 in. thick; the largest individual of the bunch about $1\frac{1}{2}$ in. by 5-24ths in. in its greatest dimensions.

Obs. As in the two foregoing species so here, there are subdermal and subcloacal dilatations of the wall-structure into which the chambers of the latter open in more or less plurality.

19. *Hypograntia intusarticulata.*

Agglomerated. Specimen consisting of one large individual with several small ones growing out about the base, all without peristomes, the former cylindrical, truncate. Colour whitish yellow. Surface uniformly even, composed of cribriform sarcode densely charged with mortar-spicules and small radiates, so as to completely exclude the sarcode itself, which is thus faced by a minute hispid reticulation. Pores, that is the interstices of the reticulation, large, varying in size under 1-360th in. in diameter. Vent terminal, circular, without peristome, leading into a narrow cylindrical cavity, which, after a short distance, becomes wider and irregular in form as it extends into the smaller individuals; holes of the cloaca subcircular, very irregular both in size and distance apart, corresponding with the width of the spicular or skeletal framework of the cavity; presenting within their margins respectively from one to four openings in connexion with the chambers of the walls. Structure of the wall like that of *Grantia hirsuta* &c., viz. consisting of subradial chambers intercommunicating with each other by large holes as well as the usual pores; partly "articulate" and partly "inarticulate" in the composition of their skeleton, that is the small radiates occupying the *inner* third and the larger ones, through their long shafts, the *outer* two thirds of the wall. Spicules of three kinds, viz. acerate, triradiate, and quadriradiate:—1, acerates, minute, sinuous, thicker towards one end than the other, viz. that which is lance-pointed, about 16 by $\frac{2}{3}$-6000th in., in short the "mortar-spicule;" 2, triradiates, regular and irregular or sagittal, of two sizes, viz. one small and the other large, with long shafts averaging 60 by 3-6000ths in., and arms about half this length; 3, quadriradiates scanty. No. 1 is confined to the surface, where, together with small radiates, it acts as the mortar-spicules of the dermal reticulation; no. 2, viz. the triradiates, in their smaller size, occupy the "articulated" portion of the parenchymal chambers, and the large ones the "inarticulated" part, where their heads are fixed in the cortex and their long shafts traverse the outer two thirds of the wall perpendicularly to the surface; no. 3, the quadriradiates, are chiefly confined to the surface of the cloaca, where the fourth arm, which is large, projects into the interior with its curve towards the mouth of this cavity. Size of specimen,

which is rather compressed, $\frac{3}{4}$ in. long by $\frac{1}{3}$ in. in its greatest transverse diameter.

20. *Hypograntia medioarticulata.*

Individualized. Pyriform, sack-like, peristomed, turned to one side at the fixed or small end, pear-like. Colour grey. Surface uniformly even, consisting of cribriform sarcode densely charged with mortar-spicules and small radiates, in short, exactly like that of *H. intusarticulata*. Pores, that is the holes of the cribriform structure, also about the same size, viz. varying under 1-360th in. in diameter. Vent single, circular, surrounded by a peristome; leading into a narrow cylindrical cavity, corresponding in shape with that of the outward form of the body, that is being widest above, where it is a little less in diameter than the maximum thickness of the wall; surface of the cloaca presenting large subcircular holes separated from each other by a thick and densely spiculated framework, sparsely echinated with thick curved spines (the fourth arm of the quadriradiate), more or less covered with a thin layer of sarcode which spreads itself in a cribriform state all over the surface of the cloaca, where it is best seen under the microscope in a dried condition. Structure of the wall in general like that of *H. intusarticulata*; also partly "articulate" and partly "inarticulate," but with the small radiates or articulate skeleton occupying the *middle* portion, the larger ones with their long shafts the *outer* half, and the smaller ones of this kind the *inner* quarter of the wall. Spicules of three kinds, viz. acerate, triradiate, and quadriradiate:—1, acerates of two forms, viz. the long, thin, cylindrical, glistening one of the peristome, and the other, the mortar-spicule, varying in size under 22 by 1-6000th in., more or less straight, *without* lanciform end; 2, triradiates, small and large, regular and irregular or sagittal, the large ones with straight shafts averaging 60 by 4-6000ths in. and arms about half this length; 3, quadriradiates, in which the fourth arm is comparatively stout and long. No. 1, in its longest form, is confined to the peristome, and in its shortest, viz. the mortar-spicule, to the dermal reticulation; no. 2, the triradiates, in their smallest size, occupy the "articulated," and the larger ones the "inarticulate" portions of the chambers, where their heads are fixed in the cortex and cloaca, and their long shafts traverse the outer and inner parts of the wall respectively, perpendicular to its sides; no. 3, the quadriradiates, chiefly in the surface of the cloaca, where the fourth arm projects into the interior and is more or less covered with the sarcode which, in a cribriform condition, lines the

cavity throughout, as before stated; also in a minute form echinating the interstices of the dermal reticulation, to which it thus imparts an additional hispid character. Size of specimen about 5-12ths in. long, and 2-12ths in. in its greatest diameter.

Obs. This specimen is remarkable for presenting the delicate sarcodic network over the surface of the cloaca which seems to occur occasionally (see Häckel's representation of *Leucetta pandora*, 'Atlas,' Taf. 22. fig. 3 *b*), sometimes, as in this case, occupying the whole of the cavity with its clathrous structure; also for the large size but sparse distribution of the fourth arm of the quadriradiate over the cloaca. Although like the foregoing species in many respects, it differs from it in general form and in the possession of a peristome.

In the last three species the "articulated" portion of the radial chamber is on the outside, the inside, and in the middle respectively, while the other portions respectively are supplied by the so-called "*in*articulated" skeletal structure.

Observation.

Still following the structure of the "wall" for arrangement, it becomes necessary to separate those species which present *no trace whatever* of "radial chambers" from those which do, although in a modified form, such as those last mentioned. Hence they will be generically named "*Heteropia*," in reference to the holes in the sarcodic structure of the wall, which here is traversed by the shafts of more or less large triradiates unaccompanied by smaller ones.

HETEROPIA.

Calcareous Sponges in which the wall is simply composed of sarcode supported on large sagittiform triradiates, whose heads are fixed in opposite sides of it respectively, and whose long shafts, extending perpendicularly across it, more or less overlap each other*.

21. *Heteropia polyperistomia.*

Individualized, social. Globular, elongate, rather bent upon itself, presenting six or more small, conical, glistening peristomes scattered over the body, which is otherwise echinated with thick, club-shaped, much curved, acerate spicules directed forwards. Colour grey-brown. Surface consisting of a rough, uneven, reticulate structure composed of the arms

* A similar structure is represented by Häckel in his illustrations of *Sycilla* (Atlas, Taf. 43. figs. 6, 9, and 10); but to say that it is composed of "Radial Tuben" appears to me to be a stretch of imagination.

of radiate spicules intercrossing each other, through which the curved sickle-shaped acerates project. Pores in the interstices of the dermal reticulation. Vents in plurality, scattered over the surface, at least six in number, each provided with a conical, glistening peristome, which contrasts strongly with the grey colour of the body, and all opening into a single cloaca, which is narrow, corresponding in shape with that of the specimen; in width about the same as the thickness of the wall; holes of the cloaca large and subcircular, separated from each other by variable distances in proportion to the width of the intervening spicular framework of the cloaca, presenting *within* their borders respectively one or more circular openings which appertain to the structure of the wall. Structure of the wall no longer presenting any trace of radial chambering beyond the parallelism of the long shafts of sagittal triradiates which successively following each other chiefly from within outwards traverse a simply clathrous cancellated sarcode, the shafts of the larger or inner triradiates being met by those of the smaller ones descending from the surface. Spicules of two kinds, viz. acerate and triradiate:—1, acerates of two forms, viz. one thin, straight, cylindrical, glistening, and silky, sharp pointed at each end; and the other thick, unequally fusiform, that is the outer portion being thicker than the inner one, and so curved in the outer part as to be almost sickle-shaped, about 150 by 2-6000ths in.; 2, triradiates, small and large, the latter averaging 100 by 6-6000ths in. in the shaft, and 40 by 4-6000ths in. in the arms respectively, which are spread out in a sagittal manner. No. 1, in its thin form, confined to the peristomes, and in its thick one to the surface generally, where it is curved towards the mouth, the larger or free end externally and the other attenuated and imbedded halfway through the wall; no. 2, the triradiates in their smaller forms chiefly confined to the spicular structure of the surface and that of the cloaca respectively, and the large ones to the wall, where the largest, whose measurements have been given, have their heads in the cloaca and their shafts directed outwards to meet the smaller ones which come from the surface. No quadriradiates were seen. Size of specimen 7-12ths in. long, by 5-12ths in. transversely. Two smaller ones growing from the base give the "social" character.

Obs. This specimen may be recognized by the number of small glistening peristomes scattered over the surface, the presence of the large sickle-shaped acerates of the surface, and the absence of the quadriradiate.

22. *Heteropia patulosculifera.*

Agglomerated. Specimen consisting of a large bunch of inflated sac-like individuals of different sizes irregularly growing out of each other, more or less conical, and opening respectively by, for the most part, large mouths indistinctly peristomed. Colour whitish yellow outside, sponge-brown within. Surface consisting of cribriform sarcode *without* mortar-spicules, knitting together triradiates, both regular and irregular, of tolerably uniform size, which is rather small; echinated, especially towards the mouth, with large, curved, fusiform acerates, sublanciform at the *free* end. Pores, the holes of the cribriform sarcode, small and large mixed, the latter about 1-280th in. in diameter. Vents single, terminal, more or less large as the free end of the individual is more or less conical, each provided with a short peristome, and all leading to a more or less general cavity which is rendered irregular in form by its branch-like extensions into the different individuals of the mass; far exceeding in size the thickness of the wall, which is thus reduced to a mere shell-like thinness; holes in the cloaca numerous, tolerably uniform in size and distance apart, each presenting one or more sphincter ed apertures under the common level of the cloacal layer; these belong to the wall-structure, and thus simulate subcloacal cavities. Wall very thin, as before stated, compared with the bulk of the individual and the largely dilated cloacal cavity, about 1-40th in. in diameter, consisting of empty sinuous canals in juxtaposition, intercommunicating by pores and large holes respectively, the latter giving it a clathrous appearance; "holes" of intercommunication larger immediately under the pores of the dermis, simulating "subdermal cavities," and the same under the cloaca; skeletal structure chiefly composed of large triradiate spicules with long shafts, whose sagittal heads support the cortex on one side and the cloaca on the other, while their shafts more or less overlap each other horizontally in the intervening space. Spicules of three kinds, viz. acerate, triradiate, and quadriradiate:—1, acerates of two forms, viz. one thin, long, straight, cylindrical, similarly pointed at each end, and the other thick, curved, fusiform, and lanceolate at the free end, measuring about 140 by 10-6000ths in.; 2, triradiates of different sizes, large and small, regular and irregular, the largest sagittal much exceeding the rest in dimensions, being about 90 by 6-6000ths in. in the shaft, with arms respectively about half this length; 3, quadriradiates, similar in size in their triradiate portion to the small triradiates, with the addition, of course, of the fourth arm. No. 1, in its finer form, is confined to the peristome,

and the stouter one with lanciform end to the surface, the latter also mingling (as before stated to be the wont of the surface acerates) with the proximal ends of the peristome spicules; no. 2, the triradiates in their largest size occupying the position mentioned; and no. 3, the quadriradiates, mixed with the small triradiates, in the cortex and the cloaca respectively; in the latter, the fourth arm is short, small, and so sparse as to be hardly noticeable. Size of specimen, which of course, from its composition, is very irregular, about $1\frac{1}{2}$ in. each way.

Obs. On the surface of the cloaca may be seen small holes about 1-1000th in. in diameter, which appear to be pores like those of the surface, as I have before stated; and here I would observe again that if the differences in form, position, and size of the spicules respectively in a Calcareous Sponge are to be severally noted, it must be done in a special description of the species itself, which would thus become far too elaborate for practical purposes, so that, in a Handbook of Sponges generally, some medium course must be adopted to attain this object.

23. *Heteropia macera.*

Agglomerate. Consisting of several individuals united together, whose form separately would be cylindrical, sacciform, and peristomed. Colour whitish yellow outside, sponge-brown within. Surface even, uniformly consisting of moderately large triradiates fixed in position by cribriform sarcode. Pores, the holes of the cribriform structure, which are very distinct but not particularly large. Vents of the individuals respectively terminal, circular, and each provided with a peristome, leading into a general cloacal cavity, which is narrow and cylindrical at first, but afterwards becomes wider than the wall of this cavity as it spreads itself out into the cloacal dilatations of the rest of the individuals in the mass; holes of the cloaca large generally, but still variable in size and distance apart, corresponding with the variable width of the skeletal structure of the surface of the cloaca. Structure of the wall like that of the last species described, viz. *H. patulosculifera*, that is, consisting of horizontal intervals defined by the long shafts of sagittal triradiates which, coming from opposite sides of the wall, overlap each other, while the intervals, which are chiefly composed of sarcode, intercommunicate with each other by large holes in addition to the usual pores. Spicules of two kinds, viz. acerate and triradiate; no quadriradiates:—1, acerates, of three forms, viz. that usually composing the peristome, among which proxi-

mally may be found shorter ones with lanciform ends; minute ones or mortar-spicules, both straight and sinuous, the latter with lanceolate ends, varying under 30-6000ths in. long, with which the cribriform structure of the surface is more or less charged; and, lastly, large and much curved fusiform acerates about 180 by 15-6000ths in., echinating the surface chiefly towards the mouth; 2, triradiates, of the surface generally, moderately large, regular and irregular, or sagittal; and of the wall much larger, where their shafts vary under 150 by 12-6000ths, with each of the arms a little less. No. 1, respectively, in its thin form confined to the peristome, in its minute one to the surface, where, in combination with the cribriform dermal sarcode, it fixes in the triradiates of this part; and the stouter form chiefly to the region of the mouth, where its much curved and thickened portion, which is outside, is directed towards this aperture, and its attenuated one sunk deeply into the *wall* of the specimen. No. 2, triradiates, to the dermal and cloacal surfaces and the wall; in the latter, their long straight shafts overlapping each other, as in the foregoing species, divide the structure into horizontal intervals, while their arms are much spread out sagitally under the spicular layers of the surface and of the cloaca. Size of largest group, for there are two specimens each consisting of several individuals of different size agglomerated, 2-3rds in. high by $1\frac{1}{2} \times \frac{1}{2}$ in. horizontally.

Obs. In this species that peculiar form of the sagittal triradiate is well developed wherein the shaft, which is, as usual, straight and cylindrical, is accompanied by a vertically flattened state of the two arms; so that *in situ*, that is on the lower and inner part of the peristome, where this form of the triradiate is particularly evident, the shaft is seen to be in a line with the spicules or palisading of the peristome, while the flat arms are spread out sagittally across them—thus acting, like the cross bar of a paling, in keeping flat and in position the lower ends of the palisading.

24. *Heteropia compressa.*

Agglomerate. Specimen in form massive, compressed, irregular, consisting of variously elongated conical processes projecting irregularly from the general mass; peristomed. Colour white outside, sponge-brown within. Surface even, consisting of cribriform sarcode, knitting together tolerably large triradiates with more or less uniformity; triradiates rather elevated in the centre. Pores, the holes in the cribriform structure, averaging about 1-900th inch in diameter, among which are scattered others (? excretory) full three times

as large. Vents single, terminal, peristomed, at the ends of the conical processes respectively; all leading into a general cloacal cavity, which is thus rendered wide, irregular, and compressed, in accordance with the form of the specimen; holes in the cloaca numerous, of different sizes and distances apart, the largest more or less sunk into the wall-structure, showing *within* again the openings of the chambers of the latter; surface of the cloaca smooth, or, if echinated, it is with one of the projecting arms of a triradiate, as there are no quadriradiates. Wall comparatively thin, composed of largely cancellated sarcode traversed by equally large triradiates, whose shafts, coming from opposite sides, cross it entirely, and whose widely spread-out arms support the structure of the surface outside and the spicular layer of the cloaca within respectively. Spicules of two kinds, viz. acerate and triradiate; no quadriradiates:—1, acerates, for the most part long, thin, straight, and cylindrical; 2, triradiates, regular and irregular, of two sizes, small and large, the latter far exceeding the other in this respect, averaging for the shaft 225 by 22-6000ths in., with wide-spread arms of nearly the same length, so that it approaches an equiradiate form. No. 1 confined to the peristome, where the shorter spicules are intermixed with the longer ones which are broken off; no. 2 to the surface of the body, the cloaca, and the wall-structure; those of the cloaca towards the mouth furnished, as usual, with *flat* arms, which, sagittally expanding across the inner ends of the peristome-spicules, bind the latter down to a common level, as before stated, like the cross bars of a paling, while the shaft, which may be insignificantly short and round, is directed perpendicularly backwards. Size of specimen 1 inch high by $1 \times \frac{1}{2}$ inch horizontally.

25. *Heteropia pluriosculifera.*

Agglomerate. Specimen in form irregularly triangular, rather compressed, consisting of three individuals or lobes, each of which is provided with a peristome; growing on a small branch of a *Fucus*. Colour whitish yellow externally, sponge-brown within. Surface uniformly composed of moderately large triradiates bound together by cribriform sarcode. Pores or interstices of the cribriform sarcode large. Vents single and terminal, situated on the prominent parts of the lobes respectively, each furnished with a peristome; leading to a common cloacal cavity, corresponding in shape with that of the specimen, but much wider than the wall, which, being only 1-33rd inch thick, looks also in this case like a mere shell

to it; holes in the cloaca numerous, variable in size and distance apart in proportion to the breadth of the intervening skeletal structure of this cavity; subcircular and presenting within respectively from one to four openings which belong to the structure of the wall. Structure of the wall like that of the foregoing species of *Heteropia*. Spicules of two kinds, viz. acerate and triradiate; no quadriradiates:—1, acerates of two forms, viz. one long, straight, thin, and cylindrical, and the other slightly curved, stouter, and fusiform, the latter varying in size under 255 by 9-6000ths in.; 2, triradiates, small and large, the latter far exceeding the others in size, averaging 85 by 5-6000ths in. in the shaft, with arms 30 by 5-6000ths in. No. 1 in its thinner form is confined to the peristome, and in its stouter one echinates the surface generally, where its inner part, which is most attenuated, is deeply sunk into the wall, and its outer part, which is thicker, curved towards the plurality of mouths respectively; no. 2 in its smaller and more regular form is chiefly confined to the skeletal structure of the surface and cloaca, and the larger ones to the interior, where their straight long shafts, coming from opposite sides of the wall, overlap each other, as in the foregoing species. I saw neither quadriradiates nor mortar-spicules. Size of specimen about 4-12ths in. high by 7-12ths horizontally in its greatest diameter.

26. *Heteropia erecta.*

Agglomerate. Specimen erect, compressed, contracted towards the point of attachment, consisting of several individuals of different sizes sprouting out obliquely upwards from the general mass in conical forms, each provided with a peristome. Colour whitish yellow outside, sponge-brown within. Surface even, uniformly composed of moderately large triradiates, held in position by cribriform sarcode. Pores in more or less defined areas of the cribriform sarcode, bounded by the intercrossing arms of the dermal triradiates; large generally, but presenting two sizes, viz. one the most numerous, about 1-830th in. in diameter, and the other about 1-276th in., the latter scattered irregularly amongst the former. Vents single and terminal, at the ends of the conical individuals respectively, each furnished with a peristome, leading after a short distance from a narrow cavity in each conical portion to a general one much wider than the walls of the former, which are about 1-24th in. thick; holes in the cloaca very variable in size and distance apart, the latter corresponding in width

to that of the skeletal layer of the cavity which separates them; subcircular, presenting *within* respectively from one to four or more openings which belong to the wall-structure, so that each of these holes in the cloaca is the aperture of a subcloacal dilatation or cavity. Structure of the wall like that of *H. compressa*. Spicules of two kinds, viz. acerate and triradiate; no quadriradiates:—1, acerates of two forms, viz. one thin, straight, cylindrical, fine, silky, and the other stout, fusiform, and much curved, averaging 240 by 18-6000ths in.; 2, triradiates, viz. those of the surface, which are moderately large, regular and irregular or sagittal, and those of the wall, which are very large and long-shafted, averaging 120 by 6-6000ths in., and the arms only a little less, so that this spicule also is very nearly equiradiate. No. 1 in its thin form is confined to the peristome, and in its stouter one echinates the surface chiefly towards the mouth, where its outer portion, which is the largest, is much curved, and the curve directed towards the mouth, while the other or more attenuated one is deeply sunk into the wall of this part; no. 2, the triradiates, in their smaller and more regular forms, are confined to the surfaces both of the outside of the specimen and the cloacal cavity, while the larger and less regular ones are confined to the interior of the wall, where their straight long shafts, coming from opposite sides, overlap each other, and their sagittal arms support the structure of the surface and that of the cloaca respectively. No quadriradiates or mortar-spicules were seen. Size of specimen, which is compressed, 9-12ths in. high by 5-12ths in. in its greatest diameter.

Obs. I notice here, as in other instances, that the most dilated spaces of the wall are under the surface and the cloaca respectively, thus presenting *subdermal* and *subcloacal* cavities. The physiology of all this, and much more too, will by and by have to be explained before the nature of the sponge is fully elucidated.

27. *Heteropia spissa.*

Agglomerate. Specimen triangular, rounded, each angle formed of the outer part of a conical individual connected with a common centre; growing upon a small branch of a *Fucus*. Colour whitish yellow. Surface even, composed of cribriform sarcode, fixing in a number of triradiates of different sizes, some of which are very large, and many with one arm projecting beyond the common level, especially towards the mouth. Pores consisting of the holes in the cribriform sarcode, which for the most part are uniform in size, viz. 1-830th in. in diameter, but here and there double this width.

Vents single, one at the end of each conical lobe, each provided with a peristome, and all leading to a dilated central cavity or cloaca, whose holes are variable in size and distance apart, corresponding to the breadth of the skeletal layer of this cavity between them; subcircular, and presenting *within* respectively from one to three or more openings which belong to the wall-structure. Structure of the wall, which is about 1-23rd in. thick, like that of the foregoing species, but with the sagittal radiates still larger. Spicules of two kinds, viz. acerate and triradiate; no quadriradiates:—1, acerates of two forms, viz. one long, thin, straight, cylindrical, and the other minute, short, and also straight, averaging about 14 by $\frac{1}{3}$-6000th in.; 2, triradiates, of different sizes and different degrees of irregularity, sagittal and otherwise, the largest averaging 225 by 27-6000ths in., with arms respectively about 150 by 8-6000ths in. No. 1 is confined to the peristome in its long thin form, and in its short minute one sparingly to the cribriform sarcode, where it constitutes the mortar-spicule; no. 2, viz. the triradiate, in its smaller form, which is still comparatively large, is confined to the structure of the surface and that of the cloaca, where, in the former, one ray often projects in such a manner that, if not carefully examined, it may be mistaken for a large acerate directed towards the mouth, and the other form, which is much more sagittal, to the wall, where its shafts stretch across this part from opposite sides, and thus overlap each other, while their arms support the skeletal structures of the surface and cloaca. Size of specimen about $\frac{1}{2}$ inch in its widest diameter.

Obs. The chief characters of this specimen are its large triradiates, whose projecting arms on the surface seem to replace the large curved acerates usually found there; also the absence of quadriradiates, and therefore of echinating spines, on the surface of the cloaca.

[To be continued.]

VII.—*Professor E. Ray Lankester's Memoir "Limulus an Arachnid," and the Pretensions and Charges founded upon it.* By Professor Carl Claus.

In a recently published article, in the April number of this Journal, entitled "Professor Claus and the Classification of the Arthropoda," Prof. E. Ray Lankester has taken upon himself to bring a series of heavy accusations against me, and asserts that I have borrowed from his *Limulus*-memoir of the year 1881 the views expressed by me upon the classification of the Arthropoda, on the occasion of a communication upon the heart of the Acarina, which appeared in the 'Anzeiger